Perceived risks of pathogens for weed control

Does the pathogen harm other plants? How specific is it?

Threatened and Endangered species?

Is it toxic to earth worms? Bees? My dog?

Does it produce toxins (mycotoxins)? Does it affect humans?

Does it mutate, change/ spread in the environment?

Can you identify and track your organism in the environment?

For the most part these questions are addressed via EPA and PMRA guidelines and registration procedures and in part by TAG protocols for classical weed biocontrol.

Indigenous vs exotic pathogen

Mycotoxin

Myrothecium verrucaria (MV) fungal isolate from sicklepod (*Senna obtusifolia* L.) that exhibits bioherbicidal activity against kudzu and several other weeds.

This isolate also produces unwanted mammalian mycotoxins, i.e., trichothecenes.

Mycelium produced in liquid culture contained no detectable amounts of the trichothecene mycotoxins roridin A and verrucarin A (limit of detection 2 μg ml−1).

Safety in New Zealand weed biocontrol

- The accuracy of host range testing in weed biocontrol programmes using plant pathogens has been questioned.
- Nationwide disease surveys were conducted from 2000-2009,
- Pustules of the blackberry rust, *Phragmidium violaceum,* were found on two plants of the endemic *R. cissoides* (bush lawyer, tataramoa) at one location.
- This result was predicted from host range safety tests conducted prior to its arrival in New Zealand.

Waipara et al. 2009. New Zealand Plant Protection 62:41-49.

Host range testing

Centrifugal phylogenetic method (Wapshere) questioned.

Molecular phylogeny rather than taxonomic classification.

Mixed model equations (MME) and Best Linear Unbiased Predictors (BLUP).

Berner 2010 Biological Control 53:143-152

Early Bioherbicide Success

- Early success of Luboa, then COLLEGO and DeVine in the late 1970s and earlier 1980's.
- Followed by intensive, relatively well funded research in many countries.
- 100s of weeds targeted with fungi, bacteria, and viruses.

What has happen since the early success?

- COLLEGO™ *Colletotrichum gloeosporioides* f.sp*. aeschynomene* – northern jointvetch in rice and soybeans
- **no longer available – market too small.**

- DeVine™ *Phytophthora palmivora*– stranglervine in citrus groves
- **– no longer available - small market – too effective.**

Photo credit: Jeff Hutchinson

Constraints

- **Biological - virulence**
- **Environmental - dew period**
- **Technological – mass production**
- **Commercial – registration cost, toxicology, market size**

Watson & Wymore 1990; Auld & Morin 1995; Mortensen 1998.

Limited success

Only six new active ingredients world wide –

1. Biochon™; Chontrol™ ~~Myco-Tech Paste~~™ (all *Chondrosterum purpureum)*;
2. StumpOut™ (*Cylindrobasidium laeve*);
3. Hakatak *(Colletotrichum gloeosporioides);*
~~4. Camperico~~™ (*Xanthomonas campestris* pv. *poae*);
~~5. Smolder~~™ (*Alternaria destruens*); and
6. Sarritor™ (*Sclerotinia minor*).

Factors affecting the development and use of microbial biopesticides

Significant increase in registrations in Canada for commercial, restricted-industry and domestic uses (Bailey et al. 2010).

Increase is due in part to changes in government legislation, public awareness and end user adoption of emerging products that have lower risks to humans and their environment.

Bailey et al. 2010 Biological Control, 52, 221-229.

Biopesticides use has expanded from under controlled environments, such as greenhouses and nurseries, to being applied in forestry, urban and agricultural settings.

The demand for use in the urban environments stems from the public concern over food safety, the association of biopesticides with positive environmental effects, and preferences for organic or certified pesticide-free produce.

Concerns voiced by the general public have resulting in significant changes to legislation at federal, provincial and municipal levels.

Government legislated changes to the Pest Control Products Act in 2002 to reflect the public’s demand for pesticide reduction and to encourage the registration of lower-risk pest control products.

Biopesticides considered as part of the Reduced- Risk Products Initiative.

Since 1991, municipalities and provinces have actively banned federally approved pesticide products in urban areas in Canada.

The general public has also pressured food suppliers and grocery stores to provide pesticide-free products, thus indirectly influencing our choices in agricultural practice.

Recent bioherbicide technologies adopted in Canadian

There are two examples of successful biopesticide research and adoption in Canada: (i) *Chondrostereum purpureum* for control of trees and shrubs in rights-of-ways and its registration as Chontrol in 2002, and (ii) *Sclerotinia minor* for control of dandelions in turfgrass and its registration as Sarritor in 2007. Both Chontrol and Sarritor are sold in Canada.

Successful adoption (i.e. sales) of these technologies was market demand and reduced competition from conventional pesticides.